DOCUMENT RESUME

ED 280 430 IR 012 566

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TITLE General Education, Technology Education, and Industrial Technology in Japan. (An Internship Experience).
PUB DATE Sep 85
NOTE 63p.; Report for the degree of Doctor of Industrial Technology, University of Northern Iowa.
PUB TYPE Dissertations/Theses - Doctoral Dissertations (041)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS Comparative Analysis; Cultural Traits; Developed Nations; *Educational Environment; *Educational Practices; Elementary Secondary Education; Foreign Countries; Government Role; Higher Education; *Industry; *Labor Force Development; *Technical Education; Technology Transfer; Vocational Education; *Work Environment
IDENTIFIERS *Japan; United States

ABSTRACT

This comprehensive report on education and industrial technology in Japan begins with general descriptions of the size of the country, its economy, and the Japanese people and their cultural values. Comparative data are then presented to demonstrate differences between Japanese and American workers. Japan's intense education orientation, both historically and currently, is noted as an introduction to a general description of the Japanese educational system, including educational facilities and environments; teachers and their union; student characteristics; the national curriculum from kindergarten through high school; and national examinations for admission to a high school or a university. The major strengths and weaknesses of educational practices in Japan are identified, as well as practices which the United States should avoid. The emphasis on technical training in higher education in Japan is then discussed, and an overview is provided of the current status of vocational and technical schools as well as the universities. A discussion of industrial technology in Japan provides insights into Japan's unique government/industry relationship, as well as an overview of its industrial policies, practices, and outlook; personnel policies/management methods; production control; and differences between the Japanese and U.S. philosophies of human resource development. The concluding section uses Japan as example in discussing the need for world cooperation. A 51-item reference list is provided. (DJR)

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GENERAL EDUCATION, TECHNOLOGY EDUCATION, AND INDUSTRIAL TECHNOLOGY IN JAPAN (AN INTERNSHIP EXPERIENCE)

A Report

Submitted

In Partial Fulfillment

of the Requirements for the Degree of

Doctor of Industrial Technology

John Gindele and Joseph Gindele

Doctoral Candidates

University of Northern Iowa

September 1985

IR012566

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INTRODUCTION TO JAPAN

Country and Economy

Japan is an island approximately the size of California (about five to six times as dense), but with a population of 120 million, and has 304 people per square kilometer. Sixty-seven percent of the island is covered with forests and mountains, forcing seventy percent of the population to reside in cities. Over 12 million people live in Tokyo, its largest city and capital, with about 29 million people in the city and surrounding area. In less than four decades this overcrowded island nation, poor in natural resources and dependent upon imports for 99.8% of its oil, half of its food, and most of its raw materials, and with an average worker monthly income of under $ 1,000, has risen from the ashes of World War II to become one of the world's great manufacturing powers (Tucker, 1985).

People

The people are friendly, quiet, reserved, and dedicated workers. A conflict in work values has emerged between the older workers who enjoy work for its own sake, and the younger workers who tend to separate their working life and personal life. Having the lowest death rate in the world (Public, 1977), along with a decreasing birthrate,

the Japanese are beginning to experience problems with regard to old age pensions, medical care, and labor shortages.

Culture

The Japanese have high respect for nature and working in harmony with others. This is partly due to the fact that Japan is both monolingual and monocultural, unlike the United States. The Japanese believe nature should be admired and respected and they approach nature with humility and strive to live within its rules. In their harmonious "WA" relationship with people, when answering questions put to them, rather than saying "No" and hurting one's feelings, the Japanese may respond with unclear and indirect answers. They love being with people and place greater value on the family and group, and not the individual. The Japanese believe peace will continue so long as they give more to others and respect others. Conformity is the ethos of this culture. These authors were shocked to experience seeing one of their study group's female teenage bus conductors get struck and knocked down by a car in front of a restaurant where the group had gathered for lunch. Although not badly injured, she was visibly bruised and shaken. A bigger shock came later to our group as this girl profusely apologized to us because she believed her accident caused us anxiety and discomfort. The Japanese seem to do their best to conform and do not believe in "rocking the boat."

The biggest difference between Japanese and U.S. workers is their attitude toward work (Grosjean, 1984). In the U.S., where there are

people of many different races and religions, it is more difficult to create a feeling of oneness and team work.

For the most part, Japanese workers do not go home immediately after work. It is part of their culture to stay longer or go out drinking with their working peers. A stigma exists that if a worker arrives home early from work, the neighbors begin to think that the worker or businessman is unsuccessful--he does not have enough clients to entertain. On the other hand, the wives are upset if the husband does not come home early. The wives' lonliness has started to create drinking problems and divorce rates are increasing. (Up until 15 or 20 years ago mostly all Japanese marriages were arranged. Today, over 25% of these marriages are "love" marriages.) Some workers even sacrifice their vacation time to remain on the job, although Grosjean (1984) suggests that the perception is fading that Japanese love their jobs so much that they will work longer hours, skip vacations and sacrifice personal lives for their employer and country.

Differences Between the Japanese and Americans

Ahl (1984, p. 14) cites the following differences:

Characteristic	Japan	U.S.
risk takers	--	+++
act as individuals	---	++
equality of sexes, races	---	++
I.Q.	++	-
pragmatism	+++	+
dedication	+++	+
perfectionism	+++	-
cooperation	+++	-
politeness	+++	-

respect for authority	+++	--
loyalty to co./country	+++	--
decision by consensus	+++	--

Reisman (1984, p. 56) cites these differences between both countries:

	Japan	U.S.
1.	culture took thousands of years to develop	200 years
2.	geographically restricted	not so
3.	population constricted by geography	not so
4.	chauvinistic	not so
5.	not so	encourages new expression in literature, music and science
6.	focus on perfecting "perfect product"	develop newer products
7.	population movement is orderly, harmonious (foreign influences restricted), sense of belonging to a whole, no place for self-expression (upsets harmony)	express individualism
8.	not much entrepreneurship, no breeding ground for creativity	supports entrepreneurship & creativity

JAPANESE EDUCATION

General Education in Japan

Introduction

Historically, the Japanese have been intensely education oriented.

Although Confucian influences have stressed the importance of literacy and book learning, this orientation remains as strong today. The Japanese spend about 12% of their national budget on education, and less than 8% on military defense, while the U.S. spends over seven times as much on military expenditures as it does on public education (Beauchamp, 1982). On the other hand, U.S. military expenditures help pay for most of Japan's defense.

Much of Japanese education is a blend of the European and American system. This occurred after World War II when the U.S. occupied Japan and brought about educational and other reforms prior to deoccupation in 1952. Major changes included (1) decentralization of education, (2) 6-3-3 free education system with nine years compulsory education, (3) social/moral issues to be stressed, (4) greater emphasis on physical education and vocational education, (5) encouragement of adult education and guidance (Beauchamp, 1982, p. 15). Much of Japanese industrial success has been directly attributed to the post-war educational reform.

The Japanese have a strong belief that the family, schools, country, and society should be linked together. They believe their schools should provide fundamentals and basics, because the more drastic a change in society, the more fundamentals, cooperation and harmony are needed. The more similar a student's academic training is, the more comfortable these students will be in working intimately with each other. Striving towards consensus is viewed differently in the U.S. where diversity of viewpoints is sought, out of which one learns to negotiate and compromise (Cogan, n.d.). In this latter case, a

range of opinions represents a check on narrow-mindedness. These different goals stem from differing cultural identities.

In Japan, a centralized and standardized educational system fosters homogeneous and monocultural ties and affords learners educational quality and consensus seeking socialization. The decentralized educational system of the U.S., on the other hand, is highly valued because it fosters individual initiative and independent thinking as local and state governments guard authority over their education, and such diversity of opinion and open debate, it is believed, leads to progress. Japanese education is more intense in length and depth than that of the U.S.. In Japan, the school year begins April 1 and ends March 31. Students get only four to six weeks of vacation as they matriculate 5 1/2 days (including Saturday morning classes) per week, 240-250 days per year (as opposed to about 181 days in U.S.). The Japanese are in school 25% longer each year. By the end of grade six, they will have attended school more than one year longer than their American counterparts (Beauchamp, 1982).

Facilities and Educational Environment

The authors have had first-hand experience visiting Japanese secondary schools, post-secondary schools, and universities during the summer of 1985. Assuming that what they were shown were some of Japan's best schools, they had mixed feelings about what some of Japan's "average" schools might look like. Some school buildings were appointed beautifully, while many others appeared depressing. For

example, a number of buildings were constructed with rough cement, on the outside as well as on the inside walls. They appeared quite drab and delapidated, and the authors thought they were once again inside schools in the Soviet Union (1983 study tour). Walls were not painted and appeared filthy, floors were bare cement, hallways dimly lit, classroom appearances seemed dull and dreary. Probable reasons for such conditions is that the Japanese might be less concerned with the appearance of their facilities and more concerned with financing the learning that takes place.

The rainy season in Japan is June and July, and it rained 18 out of the 23 days the authors were in Japan. Almost all of the schools visited were not air-conditioned (except, perhaps, for a few computer rooms) and some were very uncomfortable with high heat and even higher, it seemed, humidity. One wondered that it must be difficult for students to learn under these conditions. Yet, students almost always seemed to be very attentive to the instructor and the task at hand, and almost all ignored the presence of their visitors. Fans were not turned on, students and instructors wore caps and uniforms, and they all wore their slippers! Those in the labs wore long-sleeved shirts, and some had suits and ties on. The temperatutre was in the 90 degree range and "steamy," yet getting an education was the priority of the day. Most study-tour participants were concerned with student safety as students were observed in a small, crowded chemistry lab pouring chemicals without safety goggles, while other students operated grinders and milling machines without eye protection in other areas of the school.

Teachers and their Union

Japanese teachers seem to have professional security and, unlike the U.S., society's highest respect. Teaching is looked upon as a life-long career. The teachers union is strong and highly respected. Immediate tenure is afforded to teachers who have to pass national competitive examinations. Personal and peer pressure helps to insure teaching excellence.

Teaching certificates are valid in all 47 of Japan's Prefectures for life, but it is difficult or impossible to transfer from one Prefecture to another to teach. Two types of certificates are issued: a second-class license for elementary and lower secondary schools (which involves two years of study at a university or junior college), and a first-class license to those holding a bachelors degree (Public, 1979). No new teaching position is available to anyone over 30 years of age. In addition, if one drops out of teaching for one or more years (e.g. maternity leave), that person may never teach again, because, it is believed, the educational system "will not get their money's worth out of you." Teachers receive paid bonuses three times per year, the total of which is equivalent to five months salary. A growing concern among teachers is that those who teach eighth and ninth grade, especially, are requested by the union to take judo lessons for self-defense attacks by junior high students. Reasons for much of these discipline problems relates to student exams and stress (discussed below).

Students

Standards for order and discipline prevail in order to foster learning. Student activities have a sense of purpose. According to Cogan (n.d., p. 3), in grade one a student leader would stand by his/her desk and announce: "We are now beginning our study for the first hour." The class responds in unison: "Let us begin." For the most part, Japanese students accept authority without dispute, and are used to concentrating on detailed tasks for long periods. These characteristics are deeply rooted in their culture, and as such, are not easily exportable to other countries (like the U.S.). Students take pride in and are given responsibility towards their school. They wear uniforms and slippers (consensus), for the most part, and seem very reserved, serious and quiet. They serve school lunch and spend time cleaning the building and grounds. This helps in cutting maintenance costs. Although school is compulsory through ninth grade, those who drop out of school seem doomed, since there is no system in Japan to accept dropouts (unlike the U.S.), and no school will give that student a second chance. Drop-outs usually wind up working in service-related jobs offering no life-time employment.

Curriculum

The Ministry of Education establishes the national curriculum, national exams, syllabi, and textbooks used. The subjects to be taught are provided with their aims and objectives. As a student progresses

through his/her education, those who lean towards general education and humanities will study English and French; those who lean towards science will study English and German. Subjects are similar to those in the U.S., but the Japanese have a wider range of subjects and they study them in greater depth. There is little time for distraction. Art, physical education, and music, are part of the required curriculum to develop the "whole person." In the U.S., unfortunately, these subjects as well as foreign language have traditionally been considered frills by many, and are the first to be dropped in periods of austerity. While the U.S. traditionally sets short term goals (next exam, annual/long term plans), the Japanese use long term goals as a motivational tool. They consider success to be the result of disciplined, enduring effort, not luck.

Kindergarten is optional for Japanese students, although many attend. The major difference between Japanese and American teachers at this level is that the Japanese actually participate with their children instead of just supervising them. Emphasis in grades one through six is to do careful work and develop cooperative behaviors. Elementary children receive about two hours of homework per day. At the end of the elementary or junior high school years, major educational one-week long field trips or excursions are provided with family funds. These excursions are considered a social "glue" in bringing classmates together in lifelong friendships.

Pressure is most intense in the junior high years. The curriculum is basically designed to help them pass exams. While lecturing, the textbook is followed closely in this regard. Class discussion is <u>not</u>

common at this level. Students receive two to four hours of homework per day. In junior high school vocational and educational tracks are discussed, because by the time a student becomes an eighth grader, he must decide whether he wants to "compete" for further education. The extensive preparation for exams for students in the final years of elementary, junior high or high school, indicates where students will go the following year and whether or not they will continue school. The national exams, which are administered in February and March, determines not only the educational future of the student, but also his lifetime career.

Many years of planning and hard work go into exam preparation. Over 80% of the students take outside "juku" lessons and cram courses after school, which last until 7:30 pm daily. During the school year, prior to taking an examination, the regular education program is usually ignored because of the preoccupation of exams. If one should fail the exam, there is intense pressure to study harder for one or more years. According to Beauchamp (1982), seven out of 1,000 junior high graduates delay their advancement for one year to cram for the exam. Instead of a 6-3-3 school schedule, these students have a 6-3-x-3-x-4 year schedule. The "x" represents a one or more year leave from school for which time they cram.

From junior high the student can go to work or continue in regular high school (upon passing a competitive extrance exam), or go into vocational school or a technical "college" which combines three years of high school with two years of post-high school and prepares students in engineering.

Once admitted into high school after passing the exam, three more years are spent preparing for the university entrance exam. Because some high schools are more prestigious than others, according to the number of their students who pass entrance exams for prestigious universities, some parents have been known to rent a room in a desired school district or pay someone for the use of their address or send their child to live with a relative. Parents will go to whatever extreme is necessary to ensure their child's future.

Examination Hell

The exams primarily test for detailed facts and rote memorization. They contain lots of tricky and arbitrary questions. Because of the multitude of problems stemming from these national exams, the Ministry of Education is making a serious effort to change this tradition, with Prime Minister Nakosone spearheading a drive for educational reform. Controversy also includes the idea that testing for detailed facts does not test for the student's creativity.

Since sons are pushed into higher education, and not daughters, there are great pressures on the male. The male is the central focal point of his family's efforts and finances. Although graduating from a university is considered a prerequisite to success in Japan, graduating from the "right" university is also important. The University of Tokyo is considered by many to be the number one university to graduate from, and the most difficult to gain admission. They accept one out of every 10 or 12 applicants. Peer jealousy runs high between those not

accepted and those admitted, so much so that successful students have been beaten to death by jealous peers. Success on exams is the sole criteria to entering a university. Once admitted to a university, however, the completion of a degree is considered to be almost automatic.

The negative effects of these exams are varied. Beauchamp (1982) cites the avoidance of socializing. High school students study in excess of eight hours per day, junior high and elementary students study a little less than eight hours per day as compared to college students who study a little over four hours per day. It is interesting to note that many students do not study long once they pass their exams and have been admitted to a university. This is where American university students tend to catch up and "pull-ahead" of their Japanese counterparts.

Medical problems of these students have included stomach ulcers in school aged children, and examination induced tensions such as anxiety, depression, and learning blocks. Suicides have climbed. Between 1972 and 1975 300 junior-senior high students per year have died. Seven elementary suicides per year have also occurred. One eighteen year old, whose father wanted him to take and pass the exam for a certain university or leave home if he failed, killed himself by throwing his body into the path of an oncoming train.

Strengths and Weaknesses of Japanese Education

Strengths

Cogan (n.d., p. 4) identifies seven strengths:

1. Education is Japan's national priority where school is viewed as serious business by all.
2. The curriculum focuses on the basics, including art, music, and physcial education, foreign language, science, social studies, and language development.
3. The national syllabi and text and standardizd curriculum provides uniform schooling for all.
4. Teaching is a respected profession. With job security, teachers apply their energies in the teaching/learning process.
5. The examination system focuses on long term goals.
6. Students are encouraged to learn a second language. Nearly all of them can read and write English.
7. Schools foster group behavior and social attributes required by society.

Weaknesses

The weaknesses of the system are also cited by Cogan (n.d.) and all relate to the national examination. Extreme pressure is placed upon the student. If he passes, doors to success will be opened to him. If he fails, his career opportunities are restricted. Grades one through nine are spent studying for the high school exam, while grades ten through twelve are spent studying for the university exam. Pressures turn into viloence in schools, bribery of school and exam

officials, and student suicides. Seven weaknesses Cogan (n.d., p. 4) cites include:

1. The tendency to change a student from a carefree happy youngster into serious, fatigued, emotionally distorted adolescents.

2. School violence is a major problem for eighth and ninth graders preparing for their first major test.

3. There is a rigid focus on getting students through exams where instruction usually emphasizes rote memorization. Questioning by students is discouraged.

4. Wealthier students are favored, with great financial burdens on parents who are less well-off. They aim for the "right" university and spend money on juku classes and tutors.

5. There is little chance to catch up if one falls behind, and no provision is made for late or latent talent. There is no individual attention with forty or more students in a class. A recent study by the Prime Minister's office concluded that only 26% of the students fully understand the subject matter taught.

6. The social status in one's adult life is directly linked to school achievement. Adults are judged by their level of education and university attended.

7. Weaknesses one through six above diminishes one's desire to learn for learning sake.

Practices Which the United States Should Avoid

Five educational Japanese practices which the United States should avoid, according to Cogan (n.d., p. 6), regard:

1. National System of Exams--The Japanese have no provision for dealing with latent talent.

2. Standard National Syllabi--It may make schooling more uniform, but it reduces initiative and creativity, both of which are keystones in the U.S. educational system.

3. National System for Text Selection--This allows a central agency to exert undue influence on content and textbooks.

4. Avoid a curriculum of rote memorization of facts. The Japanese can repeat what they memorize but are not taught to apply this information to the solution of problems. In the U.S. learning is applied.

5. Japanese Education for Women--Four men to every woman enters the university.

Higher Education in Japan

Introduction

Japanese and German universities graduate more electrical engineers than the U.S.. Ahl (1984) and Seering (1985) indicate that Japan has four times as many engineers as the U.S. has. As a result, far more people in business, education, and government have a technical background. As Japan's population ages, more and more people are availing themselves of higher education. Higher education may include entrance into a technical "college" after ninth grade. Here, technicians are trained in five year programs. Vocational schools are also available, but do not appear to hold much esteem among the Japanese. Entrance exams are required for admission into a two or three-year junior college or a university. Today, there are over 1,000 Japanese institutes of higher education, including 500 junior colleges

(Beauchamp, 1982). One national university exists in each of the 47 Prefectures.

There does not seem to be much cooperation between education and industry. Of the 34 million workers in Japan, most of them are trained by their enterprises, according to Mr. Matshida, headmaster of the Tokyo Metro Nakano Higher Vocational Training School, a public vocational training school. There is a great need, according to one professor, to seriously assess higher education, since it is industry, not the university, that teaches people how to work.

Vocational Schools

According to the "Conspectus of Vocational Training in Tokyo Metropolis, 1984" (Matshida, 1985, pp. 1-2), Japan has 386 vocational schools, with 18 located in Tokyo. One of these 18 schools serve the mentally and physically disabled. Over 21,000 vocational students are trained annually in Tokyo by a staff of 892 (375 instructors, 282 lecturers, 235 office staff) with an annual budget of over 8.2 billion Yen (approx. $ 35 million). Training is provided for those seeking a job or for improving abilities. Although most companies have their own in-house training program, eighty-six companies send 8,800 workers to Tokyo vocational training institutes, which also receive a subsidy from the company.

The Institute of Vocational Training, one of a number of vocational schools visited by the authors, has the responsibility to train people to become vocational instructors, to train "engineers" of

private companies, and to train public servants of government services. Its' unique Research and Development Institute (1981) produces textbooks, teaching materials, and audiovisual aids. Students who later become vocational instructors in public vocational training facilities are exempt from reimbursement of scholarships (Institute, 1981).

The outside appearance of many of the vocational buildings appeared to be delapidated. Like some of the public schools this author's group visited, not much concern is made about the filthy looking, unpainted or paint-peeling walls. On the other hand, some buildings were pleasant to look at and seemed comfortable to study in. At the Institute for Vocational Training, which is operated by the Ministry of Labor, not the Ministry of Education, students were studying throughout the building in hot, sultry weather, without any air-conditioning or fan turned on. A few computer rooms did have controlled, cool air. In a chemistry lab many students were crowded into a small room, utilizing small, narrow table tops, working in close proximity to one another with no one wearing goggles or protective eye gear. One other lab had old-style blow torches for soldering. One wood cabinetry lab had lots of space--one bench per student. It was interesting watching students use the old wooden planes. In a machine shop, students wearing long-sleeved shirts and watches, and with no protective eye gear, were operating grinders, milling machines and lathes without apparent concern for safety. In one instance, the grinder was running unattended, while another student's unprotected eyes were inches from an operating mill cutter. The instructors, who

had the appearance of wearing military style cap and uniform, did not seem concerned at all. Later, when administrator's were questioned about this, they told the visiting group that they believed the company the student will be working for will stress the safety aspect of the job. Incredible!

In regards to equipment for vocational schools, most are purchased and not donated by industry. They have a replacement schedule of seven to eight years.

The Tokyo Metropolitan Nakano Vocational Training School offers a program for elderly workers. Those over 50 years of age get free tuition and preferential treatment. A paper-hanging course was designed for them. There is an understanding of a need for attention to the mental health of workers. According to the Report of the Committee for the Study of Labor Relations (Japan Federation, 1985b, p. 18), "the combination of a heavy work load and feeling of alienation necessitates greater interpersonal communication." The suicide rate of men in their 50's is such that the number is affecting the statistics of the average life expectancy. Japan must meet the needs of the aging since technological innovations and the rate of aging is growing faster than in the U.S..

It is interesting to note some of the placement statistics from the Institute of Vocational Training. There are 10 job offers for each graduate, 20 offers if the graduate is in the mechanical, computer or electronics fields. Also, at the Nakano school, retired 60 year old teachers are encouraged to return as lecturers.

Technical Schools

It is the responsibility of the Japanese Government to fund technical education. Funds are not provided from industry. The Japanese technical college is not equivalent to community colleges in the U.S.. Programs are usually five years in length, beginning with the 10th grade. At the Tokyo Metropolitan Institute for Technical Education, students are provided with fundamental knowledge and new advanced knowledge of technology through practice. Since 1984, over 16,000 students and 3,700 teachers have been trained here since its establishment in 1960. Teachers are provided with modern, technological knowhow by self-training and through practical experience (Tokyo, 1985). At the Tokyo Metropolitan Technical College staff members may receive training one day per week, in the evening, to upgrade their skills. There is no system in place for teacher performance assessment. The instructors are assessed, however, by the number of applicants to the school and the number of job applicants seeking graduates. Only one out of four student applicants to programs at TMTC are accepted, ensuring high standards. Teachers at this college are on a 12-month contract and will spend part of their summer visiting companies to solicit the company's needs for employment. Staff members at the Nippon Electronics Engineering College are hired with both industrial and university backgrounds. Although students may experience an industrial internship, there is presently no system for professors to do likewise.

Japanese technical college programs, like those in the United

States, are varied. Some industrialists believe Research and Development should concern itself mainly with biotechnology and electronics. Others believe a new curriculum should include automation and ceramic materials. At the Nippon Electronics Engineering College (a two-year post-high school program), a course on pollution engineering was established for the first time in Japan. NECC offers 14 technical programs in 20 departments. Programs include television production, radio transmission, materials testing, robotics, environmental control, air and water pollution, acoustical engineering, medical electronics, lasers and holography. They had 72 microcomputers and 65 CAD systems available. A tour of the college was very impressive. Although certain rooms were air-conditioned, the television studio and control room in the windowless basement were not, and it was almost unbearable in the control room. The TMTC boasted of small class sizes of "40 students." After five years of training (grades 10-14), graduates can expect 100% job placement with job offers of 20 to one. A thesis is required of each technician or "practical engineer." The Tokyo Metropolitan Institute for Technical education offers programs in freeze dried foods, x-ray analysis, radar marine engineering, broadcast television, electron microscopy, fiber optics, 200 K-volt impulse generator, welding, foundry, and machine shop.

Universities

Japanese university programs are not much different than those in the U.S., although, because of problems associated with entrance exams,

it is noted that university students once admitted have an almost 95% certainty of graduating compared to 70% for B.S. graduates in the U.S. (Cogan, n.d.). After studying so long and hard to pass examinations, Japanese students seem to slow down and "coast" through university years. Japan still experiences a shortage of software and other engineers.

INDUSTRIAL TECHNOLOGY IN JAPAN

Introduction

Almost 58 million Japanese were employed in 1984, according to the Japanese Federation of Employers' Association (1985b). A unique government/industry relationship exists as a result of governmental legislation to promote industrial technology in Japan. When the government anticipates major developments that will affect the nations' economy, it encourages the private sector to make the necessary adjustments as smoothly as possible (Tucker, 1985). Much of Japan's industrial success resulted from a unique blend of cultural, historical, economic and social factors in which government policy has played a significant but not dominant role. In contrast, the United States, while making some significant progress in improving its competitive position, does not have the national strategy and consensus necessary to accelerate that progress. As a result, U.S. high technology companies must compete against Japanese enterprises supported by the Japanese government, banks and labor, all acting in concert.

Major Industries

Japan's major industries include agriculture and fishing (most of their meat and other food is imported), iron and steel (third in world output), manufacturing (such as machine tools, sewing machines, automobiles, cameras, watches), automobile (an industry that leads the world in automation and mass production), electrical appliances (consumer electronics) and shipbuilding ("Japan in General," 1983). Davidson (1984) asserts that in each industry the Japanese have entered, prices have declined, quality standards have improved, waste and inefficiency have been eliminated, and responsiveness to user needs have increased.

Government/Industry Relationship

Tucker (1985, p. 29) states that "The government and industry allocate approximately 60% of total research and development expenditures on the development of new products and processes, 25% for applied research, and only 15% for basic research." Twenty-three billion dollars is spent annually on R & D. Two percent of this budget is allocated to military research. While Japanese R & D is heavily focused on their industrial and civilian economy, the U.S. spends over 50% of its budget on military research (Tucker, 1985).

Industrial Policy Formation

Japanese industrial policy is formulated by one of its leading agencies--The Ministry of International Trade and Industry (MITI). It was reformed in 1948 to direct the reconstruction of a war ravaged economy. Tucker (1985, p. 22) lists MITI's four responsibilities: (1) formulate industrial policy, (2) manage Japan's foreign trade and commercial relations, (3) operate the patent office, and (4) ensure that industry obtains an adequate supply of energy and raw materials.

The 1960's constituted Japan's boom years which developed into a crisis in the early 1970's when severe industrial pollution triggered a near panic. Mounting public discontent over these and other social costs of rapid industrialization sparked key environmental and consumer movements in Japan. One such movement was a major shift away from energy-intensive heavy industries and petrochemicals in favor of "knowledge-intensive" light industries which would consume less energy and raw materials.

A representative organization of Japanese employers dealing primarily with labor and social issues from the employers' viewpoint was formed. The objective of The Japanese Federation of Employers' Association (Nikkeiren) is to promote a tie-in and coordination among employers' associations to ensure harmonious development of labor management relations. Forty-seven regional (prefectural) associations are affiliated with Nikkeiren. Its activities (Japan Federation, 1985a, pp. 4-9) include the following:

1. Policy formulation and implementation dealing with labor economic and social concerns and guidelines for employers

2. Cooperation with government and labor

3. Education and training which includes two-week seminar cruises between Tokyo and Manila, and the distribution of audiovisual guidance materials to high school students

4. Research on labor economy, personnel management, and labor legislation

5. Public relations, providing information on labor management issues, education, social concerns

6. International activities

Personnel Policies

Introduction

The "sunrise" system is well established in Japan. It is both an attitude and a relationship whereby every employee, both white and blue collar, works for "one general"--the company. In this sense, the company is like a family. If any member of the group is having difficulties, whether job related or of a personal nature, others in the company will help that member. This system coincides with the three aspects of the philosophy of human relations management which includes (1) respect for people, (2) Gemeinshaft theory (everyone is in the same boat), and (3) participatory management. Japanese companies want employees to think along the same lines as management.

Japanese workers for the most part are not job conscious (such job

consciousness is part of the western culture). They are employment conscious, since companies offer lifetime employment. The process of joining a company begins in the Fall. Formal exams are part of the application procedure and usually take place in December or January with a decision made in February. Companies seek prospective employees who exhibit good personality--enthusiasm and willingness to work. After acceptance into the company, the individual usually spends a number of days being oriented to the company, involving a plant tour and seminar relating to the philosophy and goals of the company. He is then asked what job he would like and then is assigned to a certain section of the company, depending on company needs and the student's major area of study. Usually a theme is given to the individual to research a particular aspect of his work, after which he will report his findings to fellow workers and supervisors. The new employee will rotate through different job categories every three to five years. This helps to broaden the individuals experience and gives him a better feeling for the company. After about 10 years management will recommend various paths for the individual to take, such as joining management or becoming a specialist in the company.

Employment and Retention

Since lifetime employment with fringe benefits with one company is usually the norm, workers take seriously their company affiliation. Wages are usually assessed according to length of service, ability, and job performance. Casio, a major employer, has a dual wage assessment

standard. The first consists of three parts: (1) ability, (2) experience and age, and (3) ability and seniority. The second assessment deals with the degree of difficulty of the job.

Bonuses are usually paid two or three times per year and are substantial. At Nissan, for example, employees receive bonuses in July and December which total three months of pay each period. Other companies provide four months of bonus pay. With these large bonuses, many workers are able to save 20% or more of their annual salary (Schnulle Dillon, 1984). Bonuses are generally not directly linked to a company's growth. If a company's earnings are low for one year, it is not unusual for board members salaries to be cut as much as 30% (how often does this situation occur in the U.S.?).

If a job in a Japanese company is eliminated, employees are not fired. They are usually retrained and used in other ways, even if it means that an auto worker will now tend to the company gardens or trim trees, with wages guaranteed and maintained. Some may be placed on temporary layoff. The longest layoff lasts six months, after which the employee returns to the company, whether or not a new job is available. Salary payments for layoff is usually 100% for the first month, 90% for the second, and 70%-80% thereafter, depending on the company. Japan boasts a low unemployment rate of 2%. The unemployment rate in the U.S. is 7.3% (Hoffman, 1985).

Some companies will only employ aged (retired) people (Shimizu, 1985c). Companies like Toshiba and NEC have spinout companies where formerly retired employees sell books, operate restaurants, or perform other company-related services. Almost all retired people (65-70 years

of age) get a second job for various reasons, such as paying bills, or anxiety about their economic future.

On The Job Training

In the United States employers generally expect the educational system to train prospective employees in certain areas of specialization. In Japan, however, employers have no real interest in the performance of prospective student employees at the university since they have already proved their intelligence and diligence (Cogan, n.d.). Because of this belief, employers want to provide on the job training tailored to their company's needs. Since Japan's economy depends so much on human resources, it becomes more important to establish lifelong employee educational programs to train both high level specialists and generalists, to retrain those whose jobs change, and to develop natural creativity and a more internationally-oriented mentality among employees.

At Matsushita, the traditional philosophy in training employees dictates that supervisors are responsible for developing their subordinates through coaching, advising, and leading. Interpersonalization, enthusiasm and sense of responsibility become important. The subordinates, in turn, are expected to develop <u>their</u> subordinates in a likewise fashion. This corporate giant offers over 150 different in-house programs and courses. Seminars are offered by some companies both during and after working hours. Employers want their employees to have diversification of skills. This idea was first

introduced in the shipbuilding industry. It is reasoned that an employee with multi-skills helps to strengthen the industry and is one of the reasons for active quality circles in Japan. The induction period for a new employee at Matsushita is seven months during which time the worker is rotated through different jobs and areas of the plant in order to get a "feeling" of the plants' operation.

It takes ten or more years to get a new university graduate "up to speed" (DeYoung, 1985a, p. 55). Within this time the individual will find an area most suitable to him, after experiencing three or more job rotations. During this period of time, and up until about 35 years of age, the employee can begin to develop special skills. The emphasis is on career development, after which time a decision is made by the manager and the employee whether the employee is suitable for managerial training or training as a technical specialist.

Promotion

Promotion in a Japanese organization is by means of a dual ladder system where people are treated equally and morale is sustained. The status (rank) type of promotion depends upon one's length of service rather than one's ability or performance. The job type of promotion stresses one's ability and performance rather than one's length of service with the company. Company policy can vary in this regard.

Promotion at Matsushita is through enthusiasm and work performance, rather than one's educational background. At Toshiba, selection and promotion are made on the basis of an evaluation

according to a merit rating system. Priority, of course, is given to individuals who have completed company sponsored courses and seminars. Some companies assess workers by keeping a check sheet on each individual to document their ability. The check sheet is developed by the personnel department and the workers themselves. Assessment is done by the worker himself along with his supervisor. Such assessments for promotion may occur twice annually. At Casio, the results of employee assessment is in the form of increased salary and a bonus, including profitsharing. One's wage is determined by what one has accomplished in the company rather than by the level of schooling completed.

The Report of the Committee for the Study of Labor Relations (1985b) stipulates that workers welcome more overtime. They feel strongly that work gives meaning to their lives. The practice of company promotion from within serves as a powerful incentive to work more. Workers usually have opportunities to attend seminars at company training centers. Some workers stay overnight and study. It is not unusual for companies to conduct ten-day cruise seminars to Guam or Saigon, which is paid, in part, by the company. Those employees who avail themselves of additional training find their reward in company promotions.

Industrial Practices

Introduction

Japan readily admits that much of the technology for which it is now highly regarded, including microelectronics, was imported from other nations, and acknowledges the lead of the United States and others in these fields (Onosko, 1984). Grosjean (1984) attributes this occurrence to western suggestions that a strong emphasis on Japanese culture on group identity and team work, rather than individual achievement, mitigates against such innovative research.

Productivity Movement

Labor productivity in the manufacturing industry has risen much faster in Japan than in other advanced countries. In a publication entitled: "A Visual Review Productivity Movement" (Japan Productivity, 1983a, p. 3), three reasons are given for this occurrence: (1) diligence of the workers, (2) innovative efforts of managers, and (3) participation of labor unions in the productivity movement. This productivity movement began after World War II, and developed out of the Marshall Plan to recover economic controls and to prevent Soviet Communism from heading south into Japan.

To survive, post-war Japan had to introduce such a movement. Japan was determined to learn the concept from Europe and business and industrial strategies as well as investigating the frontier spirit of

the United States. The Japanese governments sent missions to the U.S. and Europe and discovered that high efficiency (input/output) developed as a result of scientific management. Since this movement was based on a national consensus with the full support of the government and private circles to achieve a self-sustaining economy and promote exports with all-out effort in introducing advanced technology from overseas, such a movement was introduced in 1955. To achieve a healthy and stable economy and to cope with many changes which affected Japan's economy, the improvement of productivity in all fields of national endeavor was essential.

The movement sought to foster a climate receptive to change by providing employment security because unemployment, they felt, was the worst thing that could happen to a human being. Secondly, it sought ways to introduce, develop and disseminate techniques of scientific management through technical exchange study tours between Japan and the U.S., where new methods could be developed and implemented on a joint and cooperative basis. Such endeavors contributed to the introduction of modern management techniques in such fields as top management, marketing, industrial engineering, materials handling, etc.. Thirdly, the movement sought to modernize labor-management relations through labor-management cooperation based on the principle of equality (Japan Productivity, 1983b).

Quality Circles

One component of education and training inside a company deals

with the participation of blue and white collar workers in quality control (Q.C.) circles. This generally involves a small group of people who are concerned with product quality and humanization within the workplace to which they belong. Quality control circles usually operate continuously for self and mutual development and for product control and improvement. The three basic tenets of quality circles are to (1) improve and develop the enterprise, (2) respect humanity and build a workplace which is meaningful to work in, and (3) display human capabilities fully and draw out infinite possibilities (Hara, 1985a, p. 1). These ideas are implemented through such methods as planning, doing, checking (evaluation) and action based upon evaluation.

For quality circles to be accepted among people, a good leader is needed. The section chief has the responsibility for inculcating the following into his subordinates: (1) excitement, (2) enjoyment, (3) entertainment, and (4) energy (vitality). In some companies, 20-30 minutes per week during the working day is spent on Q.C. circles. Sometimes additional time outside of the working day is needed. At Toyota, for instance, groups of three to ten employees meet on their own time to analyze standards of work and ways to improve their product. In another example, a newly recruited high school graduate, after three to six months of training, is assigned a certain workplace and joins a quality circle there. Within one year he must give a presentation on what the group has achieved. His former high school teacher is invited to attend. The entire division of the company and management personnel are present for a fifteen minute presentation and five minute question/answer session. The teacher commented that he was

very impressed with what the company has done with his student in so short amount of time--they "showed his potential." The truth is that the student spent months preparing for and tape recording the memorized speech (Hara, 1985).

Matsushita, the third largest electrical company in the world, was founded in 1918. To date, its 145,000 employees have submitted over 4,630,000 suggestions related to quality control. At Nissan, Q.C. circles are voluntary while at Casio there are no Q.C. circles because the fashion has faded in lieu of more scientific quality control using more sophisticated technical and statistical methods.

According to the Summary of QC Circle Activities in NKK, 1984 (Hara, 1985b, pp. 1-2), there were 3,842 Q.C. circles with a participation of Nippon Kokan's 23,479 employees. There were 15,198 themes completed with percentages shown: Quality (20), Yield (3.5), Energy Saving (6.4), Materials Saving (3.5), Productivity (24.4), Management Skill (8.9), Safety (23), Equipment (6.5), and Others (3.5). Job improvement proposed suggestions amounted to 146,687 (6.2 per person), with 120,219 adopted proposals (5.1 per person). Eighty-two percent of the proposals were adopted.

Management Methods

A number of management methods have become established industrial practices affecting the quality of products in Japan. Seven methods are listed here:

Consensus

Decision making finds its roots in early childhood. As part of a group, one must conform without overt disagreement. The Japanese value the "WA," or harmonious way of life, and suggests that individuals conform to the thinking of their fellow employees. One does not tell a Japanese person that one disagrees with him or her, even in the most polite way (Schnulle Dillon, 1984). This would be considered a very aggressive act labeling the "aggressor" as a troublemaker in the group. Many companies begin the day by having their workers do five to ten minutes of calisthenics followed by employee briefings.

Employee Loyalty

"Employee loyalty" is a second method of employee control utilized by Japanese industrial and business management personnel. Most workers trust that their loyalty will be rewarded. Workers in the U.S., on the otherhand, are usually rewarded for their personal merit by being hired and promoted. Japanese managers are directed to have strong personal relationships with the worker and his family, and will sometimes visit the worker's home and offer advice in solving family problems, dating, and other personal and intimate matters. Japanese workers are obedient to their company and hierarchy. At Toyota, autoworkers have a sense of mission. Doing a good job is important to them, their company, union, family and nation. Worker alienation is unheard of and sabotage within the company is unknown. In one situation, the captain of a ship carrying Suburu automobiles from Japan to Los Angeles discovered that 200 automobiles were damaged by waterleaks in the cargo hold. He

considered himself personally responsible for the damage and attempted to commit hari-kari. When that failed he slit his throat ("Industrial," 1980, p. 53).

Japanese companies listen to workers suggestions or complaints and share good and bad times. If company profits should fall, executives take large pay cuts along with workers. The average Japanese employee makes more than one suggestion each week (Grosjean, 1984). In 1983, Matsushita's 80,000 workers made 4.8 million suggestions or 59.8 suggestions per worker. When vacation time approaches, most workers in Japan take only half their alloted time off, and they take genuine sick days. Some workers will work for one or two weeks during their vacation time. Many managers believe that if they take their alloted vacation time, they would be neglecting their responsibility to their job. They fear (insecurity) that if they leave their job for a holiday they will have their jobs taken away. Some believe the work will not progress without them. When the work does progress in the absence of the employee, that employee believes he must work even harder upon return to prove that he is needed. Most workers believe that management expects them to behave this way. There is also a jealousy aspect in that if one goes on vacation, other workers may feel the vacationer is having too good of a time. On the other hand, the vacationer may believe that other workers would have to pick up his extra work load, and this would definitely be undesireable.

Lifetime Employment

The Japanese are concerned with relationships and will introduce

themselves first by their company name and then their family name. While they advance in their company through a series of jobs or skills, U.S. workers advance in a profession or skill through a series of companies (Grosjean, 1984). While Japanese employees are allowed to leave their enterprise, many do not. They remain with the company through retirement age (55-69). Lifetime employment tends to promote a feeling of cooperation between management and labor that encourages team work and high quality work. Some American companies (e.g. Hewlett-Packard, Eli Lilly, Proctor and Gamble) have adopted these policies and found that they produce high productivity and better quality goods and services (Schnulle Dillion, 1984). Spending an entire lifetime with one employer provides a closer relationship and deeper identity between worker and his enterprise.

Seniority Promotion and Wage System

A worker can join a company at a low starting rate related to age and education, and know that this wage will rise towards retirement age. Wages are usually decided by the length of service rather than the nature of the job. Also, one's wage will rise proportionally to the rise of living expenses. This system also makes it difficult for employees to change employers because employers prefer not to hire older workers (they must pay older workers more). Also, if one transfers to another company, the worker gives up his higher post and wage.

Worker Relationships

Fellow workers usually become a workers' circle of friends. It is easier to be loyal to a company when many company employees are your friends on and off the job. Since the worker's social life is with his friends, the worker's wife does not share her husband's social life, nor does he share hers. If a worker goes home right after work, he will make his co-workers and boss unhappy (Grosjean, 1984). It underminds the consensus process. The worker is expected to give extra non-paid time on the job with other workers, or socialize with his peers off the job, usually at a pub and into the evening hours. On the other hand, if the worker does not go directly home after work, his wife is unhappy, and this undermines the marriage. It is no wonder the divorce rate has increased sharply within the past six years.

Fringe Benefits

Some ways that companies give consideration to the worker and family is through allowances, welfare and recreational facilities, large retirement allowances equal to a factor of 23.4 times one's final monthly wage for those employed thirty years or more (Public, 1974). Some companies like Nissan provide over 6,000 married housing units and dormitories for over sixteen thousand workers at reasonable rates (Nissan, 1985a, p. 43).

Enterprise Union and Labor Relations

The fastest way to organize labor unions during the post-war years seemed to be on an enterprise basis. Many labor disputes occurred

around 1955 between two groups: ideological and pragmatic. Labor and management relations have stabilized, however, especially since 1965. Workers have harmonious labor relations with management through company trade unions. Collective bargaining occurs annually and management and workers view their enterprise as a social unit, a community of people. Workers are regarded as members of the enterprise, not as labor hired by it. Workers believe that if they give their best efforts to their enterprise, the worker will insure his own security and prosperity, as well as contribute to the good of the country. The feeling of "being in the same boat," heading in the same direction as management, helps workers to resolve issues and contributes to industrial peace (Shimizu, 1985b). Labor-management relations in Japan are envied by other countries. Some people attribute this to the low awareness of class distinctions between workers and management, and 90% of the workers consider themselves to be middle class (Japan Federation, 1985b, p. 19). Japan Federation (1985b) asserts that one out of every six company presidents or directors has previously been a company-union labor leader. This is further proof that class distinctions are very few. The Japan Federation of Employer's Associations considers a good trade union member to be a good employee and a bad union member is considered to be a bad employee.

Comparison of U.S./Japanese Human Resources Development

Shimizu (1985a, chart 6) compares the differences between the U.S.A. and Japan on the philosophy of human resource development:

U.S.A.	Japan
individualism	collectivism
man to job	job to man
competition between individuals	team-work
short range performance evaluation	long range performance evaluation
professional skills (specific abilities or competence for a special field)	general abilities (fundamental capability to adjust to the situations)
universal abilities	company-limited abilities (skills not as applicable to other companies)
clearly classified and qualified job (limited responsibilities)	vague[ly] defined job (unlimitedness of responsibilities)
utilization of authority (power)	coordination
contract rule	mutual trust

Japan's Industrial Outlook

Sampling of Current R & D Projects

When the need arises to reduce overhead expenditures, U.S. companies are quick to cut research and development funds (McAbee, 1979). This is not true in Japan. In their 1984 annual report, Matsushita discusses an established principle that all R & D must aim at the happiness and prosperity for all mankind. Its' 133,000 employees have produced over 14,000 different products. The company funnels 10 percent of their receipts into R & D. In 1984, their R & D budget was 820 million dollars.

Bio-technology researchers have zeroed in on health care in light

of a profitable world market in vaccines, vitamins, antibiotics and genetically engineered cell products. DeYoung (1985a) lists over 150 bio-technology companies in Japan.

The ceramics industry is receiving massive government and industry committment to develop new ceramic materials, processes and applications. Some of their ceramic products are stronger than steel, yet half its weight. They have electrical and heat transfer properties and can act as a non-insulator. Ceramics are highly corrosion and shock resistant. By 1990, Japan predicts sales in ceramics over 9 billion dollars (DeYoung, 1985b). The Toshiba Corporation claims itself as a world pioneer in silicon nitride, a new promising type of ceramic. Closely allied with the ceramics industry is the micro-chip industry where Toshiba, NEC, Hitachi, Fujitsu, Mitsubishi and Matsushita are promising to produce megabit RAMS for 1985 (Haavind, 1985a).

Optoelectronics is a field in which Japan has done much of their own basic R & D (Haavind, 1985b). Bairstow (1985b) says that Japanese optics lens designers have matched and overtaken the Germans. Minolta's new 35mm SLR camera has the eqivalent of 150,000 transistors in its integrated circuit chip, where electronics is used to control an essentially mechanical device.

Nissan has developed a Vehicle Navigation System designed to keep commercial vehicles on course. It plans delivery routes and processes orders. Nissan considers this to be "one step along the way to a mobile information office for both passenger cars and commercial vehicles" ("Vehicle," 1985, p. 7).

In consumer electronics, compact disc players are being developed which generate still frame video with 1500 limited color graphics or text to accompany sound. This can offer 32 hours of playback time which can store all Shakespeare plays on a couple of discs (Lu, 1985). Consumer optical disc recorders are farther off in development. Industrial versions are being sold, but they can record only once and cannot erase.

Future Outlook

Although these industrial sampling developments seem impressive, Tucker (1985) foresees a somewhat cloudy future for Japan. This is due basically to the rising cost of raw materials, most of which must be imported and strong competition from the "Four Dragons"--South Korea, Taiwan, Hong Kong, and Singapore (Tsongas and Tyson, 1984). These countries are rapidly improving their technology capabilities while maintaining wage scales below that of Japan. Cheaper imports have already displaced Japan's shipbuilding, steel and textile industries. Haavind (1985c), in referring to Japan's Fifth Generation (Artificial Intelligence) of computers for the 1990's and beyond, cites ICOT's Fuchi who argues for worldwide cooperation. "Global, rather than merely local efforts are needed," he says, "since the computer age will benefit all mankind."

Production Control

Introduction

The control of the production line for optimum quality output can be achieved in numerous ways. Schonberger (1982) believes that in order to close the quality gap, a company should transfer the responsibility for quality control from the QC department to production. He suggests it is difficult for Americans to believe quality can be shared and that it is difficult to pursuade American engineers and managers to go on to the production floor and mingle with the foreman and workers. Schonberger (1982, pp. 36-38) lists eight methods used to ensure quality. Since Japan's industries are committed to the prevention of problems rather than detection, "Quality at the Source" becomes the focal point and can be achieved through the following applied principles:

1. Process Control--the checking of product quality during production and stopping the process if it goes out of control.

2. Visible Measureable Quality--Quality records and improvement activities are expressed in easy to understand charts and diagrams and displayed throughout the factory. This is equally important to some outside visitors of the plant who may be customers and may be auditing production activities.

3. Insistance on Compliance--A minimum quality of standards are set. Japanese buyers have the clout to demand a consistent product, because suppliers often sell to just one or a few buyer companies and cannot afford the loss of a customer.

4. Line Stop Authority--The worker is encouraged to stop the production line anytime to halt errors.

5. Self Correction of Errors--The worker or a group of workers may have to work late if any products need to be reworked.

6. Expose Problems--Seeing defective parts brings both smiles and frowns from workers, since a defect exposes one more problem to investigate and prevent from happening again. Sometimes managers will remove inventories to create small production line delays. This is usually done so that the problems can be analyzed and eliminated.

7. 100% Check of Product Sampling--This ensures a greater output of quality products as opposed to random sampling.

8. Project by Project Improvement--Charts, graphs and diagrams provide information and recognition of current projects.

The eight "accelerators" of the pace of quality improvement described above need good support for maximum effectiveness. Five Total Quality Control (TQC) concepts to provide for this support and listed by Schonberger (1982, pp. 38-39) are:

1. Quality Control Department's Role--The primary quality control should be assigned to production so that a smaller department can more closely monitor the production.

2. Small Lot Sizes--Small production and the purchase of lot sizes are critical in assuring that defectives are caught early.

3. Housekeeping--The fetish for plant cleanliness and tidiness is one of the components of TQC.

4. Total Preventive Maintenance--Good plant housekeeping is important and should include keeping careful records on machine use and breakdown and the establishment of maintenance procedures. An airline pilot style machine checking should occur every morning before production begins.

5. Less Than Full Capacity Scheduling--A lighter scheduling load will allow workers to slow or stop production if there are any quality problems. Problem prevention reduces the need to slow or stop production.

Tools and aids to production quality control, as cited by Schonberger (1982, pp. 39-40), includes a committment to the use of:

1. Bakayoke--(Foolproof) quality control checking devices

2. N=2--No statistical random sampling, just inspect the first and last piece to detect any process change. Therefore, the sample size N=2.

3. Statistics and Other Analytical Aids--Workers should use statistical control charts, histograms, etc., to ensure high quality standards.

4. Quality Control Circles--This method began in the early 1960's when a foreman would share what he learned from a magazine with his workers. Other QC's formed later for training and problem analysis purposes.

It took ten years (1950's) for Japanese management to be trained in Q.C. and another ten years (1960's) to train the foremen and their workers. Shaiken (1985) raises the question of which is more important--technological control or humane work? He suggests managers who are intent on production control are looking to remove the skill from workers and transfer it to complex machinery. Negative effects of this have resulted in jobs that are tedious, high paced, and stressful. He contends that workers are more productive and they do a better job if they are motivated and able to use their skill, experience, and creativity.

Robots

No area of materials handling, production manufacturing or control, can be effectively examined without a discussion of robotics. The robot is a major force behind increased industrial productivity of Japan and symbolic of automation in all work areas (Onosko, 1984). A new study of the management implications of robots indicates that contrary to the increased use of robots in Japanese factories, the attitudes of workers have improved, resulting in better quality of work and greater contributions from workers on ways to improve the manufacturing process (Robots, 1984). Workers at Nissan believe that robots help them, and with the use of robots, people are not laid off--they are just reassigned to other jobs. At Nissan, robotic automation is used proportedly to supplement the manpower shortage.

Three main parts of the industrial robot includes the (1) manipulator, with degrees of freedom (# of joints) which determine its dexterity and cost, the (2) gripper, welding gun or tool used by the robot to perform its task, and the (3) controller, consisting of a computer and program to guide the robot. Blumenthal and Dray (1985) indicate that by the end of 1982 there were 32,000 Japanese robots in use as compared to 6,000 in the United States. West Germany had 4,000. Most of the Japanese robots were used to improve manufacturing technology, in light of a history of labor shortage. In contrast, the baby boom in the United States provided plenty of labor during the 1960's and 1970's, so there was no immediate rush to obtain capital (robotic driven) equipment.

Seering (1985, p. 62) lists three tasks that robots do well: (1) paint spraying (where there is no need to breathe) is faster and cheaper, (2) spot welding (less tedious and safe), and (3) installing chips on printed circuit boards. Japanese robots have less degrees of freedom than U.S. robots (which have six). Fewer joints result in faster movement and less vibration and has a direct effect on product quality. At the Nissan Motor Company where they manufacture robots and use over 1600 of them (Nissan, 1985b, p. 1) in welding, painting, and final assembly, these authors have observed robots inserting seats and instrument panels into automobiles, as well as affixing glue to rear windows and positioning the windows in place onto the automobiles. Also observed at Casio were robot delivery carts (automated carrier transports) which moved parts from the automated vertical warehouse to the assembly line. Robots were assembling calculators sixteen hours per day, six days per week. This assembly was being done to the tune of "Annie Laurie," piped in over the loudspeakers, which was used to "keep the robots from getting bored," or so the visitors were told. During this time, two Casio employees were on hand to make sure everything was going well.

Inventory Control

Seeing continuity as a virtue and waste as an evil is one of the cultural features of the Japanese approach to production control. Toyota invented a production system called KANBAN--the production control system that makes Toyota cars "just in time." Kanban means

"card," a production control system which produces the bare minimum of components, encourages workers to stop the entire production line if unable to keep up or if they have a defective part, and does away with the need for data processing (Baxter, 1984). In this respect, parts are only made when immediately needed and can be delivered direct to the shop floor. The Japanese regard stock inventory as a source of trouble, creating an imbalance between workers and processes and increasing idle time. Mitsubishi uses the just-in-time inventory system to keep less than one shift's production on hand (Bairstow, 1985a). Then, the just-in-time inventory arrives efficiently when needed and is not wasteful. Baxter (1984) believes more Japanese companies are moving towards such stockless production which has an effect on one's perception of the workday. A day's work, then, is equivalent to the quantity to be produced and not the number of hours to be worked.

Assembly of products costs five to ten percent of the price of making the product. The cost of maintaining an inventory is approximately 20 percent (Seering, 1985). Therefore, companies would do well to minimize inventories requiring that suppliers deliver only the number of parts needed at a time. The advantage of J.I.T. are twofold: (1) inventories are reduced, and (2) bad parts are immediately detected and rejected since the number of parts available is equal to the number of parts needed. At present, some assembly workers hide their mistakes in inventory. Because this system is not yet popular in the U.S., consumers may be paying more for goods due to the large number of defective items which are rejected.

Nissan Motor Company uses the Synchronized Delivery System with 200 suppliers. Parts (seats, tires, glass, etc.) are delivered to the plant on time with computer information providing a six months, one or three year production schedule. This system is more frequent than the just-in-time system. Parts delivery may occur twice per day.

Flexible Manufacturing System

Although it was introduced in the U.S., Flexible Manufacturing System (FMS) is being adopted in Japan. The Japanese management philosophy which emphasizes long term performance is more attuned to FMS. Casio uses this system of factory automation to produce 16 different calculator models. U.S. management practice is presently not too enthusiastic about FMS because U.S. dominance of world markets have provided little incentive for making expensive investments to boost productivity. U.S. practice tends to emphasize short term goals and reduction of risk. FMS requires heavy capital expenditures and long lead times (Kinnucan, 1983).

Advantages of FMS includes faster and systematic movement of parts and a reduction in inventories (smaller batches are made to order). Disadvantages include cost ($600 to $800 thousand dollars per machine workstation). Minimum expenditure is three to four million dollars. Secondly, the breakdown of one component could shut the entire system down because it is highly integrated. Thirdly, automatic material handling system (long neglected in industrial research and which serves as a "glue" to bind the factory together) is troublesome (Blumenthal

and Dray, 1985).

APPRECIATION AND INTERDEPENDENCE OF COUNTRIES

World Travel Experience

Communication and transportation technology has been a key factor in bringing world cultures closer together. Travel also helps to increase one's awareness of the lifestyles and cultures of people living in other countries. These authors have had the opportunity to visit sixteen foreign countries for both pleasure and/or study of educational systems and industrial technology during the past two decades. They share an opinion that countries cannot survive and thrive in a vacuum by themselves, but need to cooperate and share their resources with other nations on a mutual basis.

Need for World Cooperation

"The Shrinking World"

Using Japan as an example, Japan imports food and raw materials and exports technology (Shishido, 1983). Japan manufactures over one-half of the television sets used in the world, is the only meaningful producer of videocassette recorders, dominates the 64-K RAM computer chip sector (75% global market), and leads the way in artificial intelligence research. In addition, Japan became the

world's largest shipbuilder, number one automaker, leading textile manufacturer, chief producer of heavy industrial machinery and equipment, and produces more steel than any other country (Schlossstein, 1984).

International research and development can affect the world in different ways. In Japan, robotics is changing the way products are manufactured. Fiber optics is changing the way people communicate. Even genetic engineering is changing the natural chemical process of life (Tsongas and Tyson, 1984). Koji Kobayashi, Chairman of the board for the NEC Corporation, envisions the day when anyone can talk to anyone, anywhere in the world. He believes understanding between nations needs much improvement and is convinced that ". . . a free exchange of ideas between peoples of different countries, assisted by advanced technology, could contribute greatly to world peace." (Kobayashi, 1985, p. 10). As an example, he foresees the commercial development of an interpretation telephone system by the year 2000 which would not only assist daily business activities but also improve international relations tremendously. Such technology may assist in the appreciation of people's lifestyles and ways of thinking. Also, this may help to free-up the vast volume of information so that it can more easily move across borders. This may then bring about a truly information-oriented society.

World Economy and Employment

Tucker (1985, p. 30) believes that ". . . Japan recognizes its

responsibility to participate in international cooperative research that will contribute to the economic health of the world as a whole." While visiting the Institute of Vocational Training in Japan, these authors learned that the Institute has developed a four-year Rehabilitation Engineering program synthesizing engineering, medicine, and educational psychology. This is a first world attempt for an institute of higher learning to enter into such an endeavor.

Many nations of the world have companies in operation around the globe. Japanese auto manufacturer Nissan, for example, employees over 60,000 workers in 26 assembly plants located in 22 countries. Nissan is committed to internationalism with local production facilities abroad. This helps to employ foreign workers in their own country, adding to the economic structure of that country, and it introduces technological awareness (production processes and products) to that geographical area.

Drain on Natural Resources

As populations continue to grow on a finite area of the globe, more food, shelter and energy are needed. The depletion of natural resources is just one of the results of such change. Countries lacking food and energy (oil, coal, gas) must depend upon those who have an abundent supply. The interdependence of countries may be clearly seen through international trade--the import and export of goods and services--and mutual cooperation in the attainment of similar goals.

International Technology Exchange

World Fairs and expositions clearly attempt to show the necessity of cooperative endeavors. These authors had an opportunity to visit several world's fairs, the latest of which was Japan's Exposition '85, last June. Pavilions and themes at TSUKUBA EXPO '85 centered around the international exchange of foreign governments and corporations. The theme was "Dwellings and Surroundings--Science and Technology for Man at Home." One objective of this Expo was to consider ways to integrate major scientific and technological advances into the life of humans throughout the world. A sampling of some pavilions and themes include: (1) This Varied Land of Ours, (2) Humans Life in Future, (3) The Universe, (4) For a New Future: Nature, Science, Humans, (5) Wonderful Relations: Nature, Science, Humans, (6) Human's Love of Nature--Our Hope for Future, (7) Good Day! Nice Friends, (8) Wonderful World, Beautiful People, (9) In Quest of Mobility, (10) What Humans can Dream, Technology can Achieve, (11) Super and Extreme World, (12) Humans and Computers and Communications, (13) Biotechnology for the 21st Century, (14) Global Communications Now.

Harmony and trade are two of the things most foreign governments strive for. An international technical exchange which helps to provide exposure to more advanced ideas and technology in advanced countries and opportunities to introduce them in well adapted forms to fit local conditions, could be considered a kickoff point for a worthwhile productivity movement. One objective of the Japanese Productivity Center is to facilitate the international flow and exchange of

information on productivity in order to contribute towards improved productivity in countries around the world. One of the ways they meet this objective is through two week-long productivity cruises in the Asian region, where participants visit industrial plants and exchange views. These cultural exchanges occur two or three times per year and have included over 12,000 participants. The more involved foreign countries become in international trade for the betterment of mankind, the more beneficial such cultural exchanges may be for those countries and their people.

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